Title: Remote Sensing of the Seasonal Variation of Coniferous Forest Structure and Function

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Discipline: Land

One of the objectives of the Oregon Transect Ecosystem Research (OTTER) project is the remotely sensed determination of the seasonal variation of leaf area index (LAI) and absorbed photosynthetically active radiation (APAR). These measurements are required for input to a forest ecosystem model which predicts net primary production, evapotranspiration and photosynthesis of coniferous forests. The OTTER study area includes six coniferous forest stands along an east-west trending temperature and moisture gradient across western Oregon. Remotely sensed determinations of LAI and APAR will be made from Thematic Mapper Simulator (TMS) data acquired from a Daedalus scanner onboard a NASA ER-2 high altitude aircraft collected during a Multi-sensor Aircraft Campaign in support of the OTTER project.

The TMS data were acquired for the OTTER project during four time periods in 1990. The time periods were in March (pre-budbreak conditions), June (maximum LAI and understory), August (maximum LAI, understory senescence) and October (reduced LAI). Field measurements of leaf area index and absorbed photosynthetically active radiation were made at each of the six sites during the four time periods. Measurements of LAI were made using allometric equations relating diameter at breast height and sapwood basal area to leaf area index for each of the forest stands. The seasonal variation of LAI, and the APAR for each stand was calculated using ceptometer measurements of the amount of incoming photosynthetically active radiation and absorbed radiation under the forest canopy during the four time periods.

Field spectral measurements were made of the understory at some of the sites using a Spectron 590 spectroradiometer and a Barnes Modular Multiband Radiometer. A low altitude ultralight aircraft obtained Spectron and Barnes measurements of the coniferous forest canopy during the four time periods at most of the sites. These measurements will be used to help interpret the soil and vegetation background contribution to the TMS data. Measurements of atmospheric optical properties were made at the study sites concurrent with the four TMS data acquisitions. These measurements were made with two ground based Sunphotometers, allowing a determination of the aerosol optical depths. Atmospheric correction of the TMS data will be performed using a radiative

transfer model from measurements obtained by the Sunphotometers at each of the OTTER study sites.

Relationships will be determined between single channels of TMS data and LAI and APAR, as well as relationships between TMS near infrared/red radiance and LAI and APAR. Previous relationships developed between near infrared/red radiance and LAI will be used to estimate LAI for the OTTER study sites. Seasonal variability of LAI and APAR will be analyzed with respect to the seasonally acquired TMS data. The Sail canopy model will be used to help understand the relationships between LAI, APAR and TMS data. Preliminary analysis indicates that the TMS data are of high quality. The TMS was calibrated just before or just after each flight. Analysis of the Sunphotometer data indicates that there was considerable variability in aerosol optical depths both between time periods and between sites during the data acquisition periods (Figure 1). The August data had very high optical depths, resulting from field burning near some of the sites. Sunphotometer data acquired during March and June show very clear atmospheric conditions. These early results highlight the necessity for measurement of atmospheric optical properties concurrent with remotely sensed data acquisition, particularly when analyzing remotely sensed data acquired from different locations at different times.

AEROSOL OPTICAL DEPTH: OTTER SITE 3
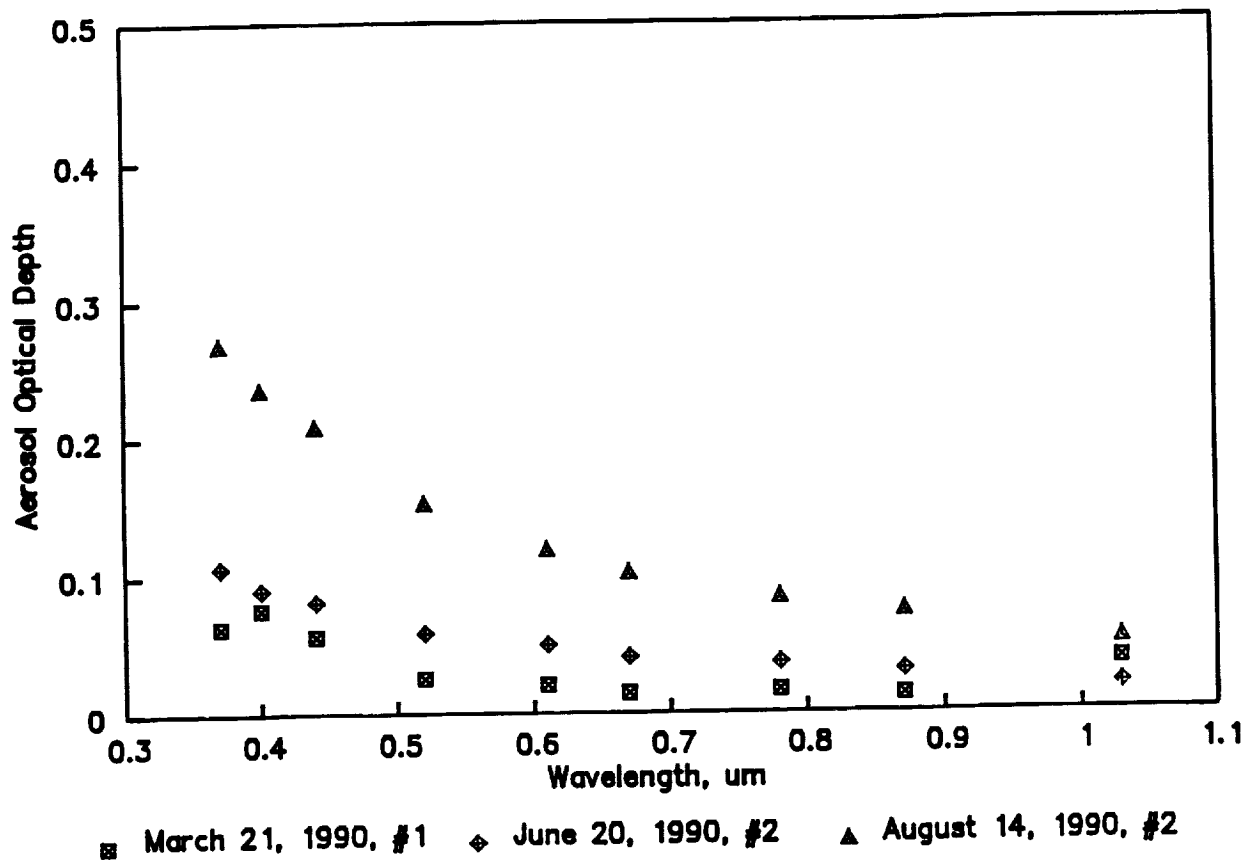### Instruments 1 & 2

Figure 1. Aerosol optical depths measured at OTTER site 3 in the Cascades Mountain Range in March, June and August concurrent with the ER-2 overflight.